CLAIMS

What is claimed is:

1. A method of allowing a mobile robot to return to a designated location, wherein the designated location has a sound wave transmitter and the mobile robot has a sound wave receptor and the mobile robot automatically returns from a first location to the designated location, the method comprising:

calculating a first direction angle of the mobile robot at a second location arrived at after the mobile robot travels a first distance from the first location;

determining whether the mobile robot approaches or moves away from the designated location, at a third location arrived at after the mobile robot rotates by the first direction angle and then travels a second distance; and

if the result of the determination indicates that the mobile robot approaches the designated location, controlling the mobile robot to travel according to the first direction angle, and if the result indicates the mobile robot moves away from the designated location, calculating a second direction angle of the mobile robot at the third location, and controlling the mobile robot to travel according to the second direction angle.

2. The method of claim 1, wherein the first and second direction angles are calculated by using a distance between the mobile robot and the designated location calculated from a time difference between a time when the sound wave transmitter transmits a sound wave and a time when the sound wave receptor receives the sound wave, and a travel distance provided by an encoder connected to a motor of the mobile robot.

3. The method of claim 1, wherein the calculating the first direction angle comprises:

at the first location, calculating a first distance between the mobile robot and the designated location;

after traveling the mobile robot to the second location from the first location, calculating at the second location a second distance between the mobile robot and the docking station; and

calculating the first direction angle by using the first distance, the second distance and a travel distance between the first location and the second location.

4. The method of claim 3, wherein the determining whether the mobile robot approaches or moves away from the designated location comprises:

rotating the mobile robot by the first direction angle in an arbitrary direction and traveling the mobile robot to a third location;

at the third location, calculating a third distance between the mobile robot and the designated location;

estimating the distance to the designated location from the third location after the mobile robot rotates by the first direction angle in the direction of increasing distance from the designated location and travels a predetermined distance between the second location and the third location; and

comparing the calculated third distance with the estimated distance.

5. The method of claim 4, wherein the controlling the mobile robot to travel comprises:

calculating a second direction angle of the mobile robot by using the second distance, the third distance and the travel distance between the second location and the third location;

if the result of the comparison indicates that the third distance is different from the estimated distance, controlling the mobile robot to travel according to the first direction angle; and

if the result of the comparison indicates that the third distance is the same as the estimated distance, controlling the mobile robot to travel according to the second direction angle.

6. The method of claim 5, wherein rotating the mobile robot by the first direction angle in an arbitrary direction comprises:

if the first direction angle is an acute angle, the rotation direction of the second direction angle is controlled to be opposite to the rotation direction of the first direction angle; and

if the first direction angle is an obtuse angle, the rotation direction of the second direction angle is controlled to be the same as the rotation direction of the first direction angle.

7. The method of claim 2, wherein the time difference between the time of transmitting the sound wave from the designated location incident on the mobile robot, and the time of receiving the sound wave is calculated based on the transmission and reception time points of a predetermined time synchronization signal from the designated location incident on the mobile robot.

8. The method of claim 7, wherein a speed of transmission of the time synchronization signal is faster than a speed of transmission of the sound wave.

9. The method of claim 7, wherein the time synchronization signal is one of an infrared (IR) signal or a radio frequency (RF) signal, and the sound wave is an ultrasonic wave.

10. The method of claim 2, wherein the time difference between the transmission time and the reception time of the sound wave from the designated location incident on the mobile robot is calculated based on a predetermined timing signal.

11. The method of claim 2, wherein the travel distance provided by the encoder is compensated for an error caused by slipping on a ground, by a Kalman filtering technique using the first through third location information.

12. The method of claim 1, wherein a program enabling the method is recorded on a computer-readable recording medium.

13. An apparatus for allowing a mobile robot to automatically return to a designated location from a first location, the apparatus comprising:

a sound wave transmitter installed on the designated location transmitting a sound wave;

a sound wave receptor installed in the mobile robot receiving the sound wave;

a distance calculator which calculates a distance between the designated location and the mobile robot, by using a time difference between times of transmission and reception of the sound wave transmitted by the sound wave transmitter to the sound wave receptor;

an encoder connected to at least one or more motors and measuring a travel distance and a travel direction of the mobile robot; and

a travel controller which by using the distance calculated in the distance calculator and the travel distance measured by the encoder, calculates a first direction angle at a second location arrived at after the mobile robot travels a first distance between the first location and the second location, determines whether the mobile robot approaches or moves away from the designated location, at a third location arrived at after the mobile robot is rotated by a first direction angle and travels a second distance between the second location and the third location, and controls the mobile robot to travel according to the result of the determination.

14. The apparatus of claim 13, further comprising:

a time synchronization signal transmitter included in the designated location and generating and transmitting a time synchronization signal; and

a time synchronization signal receptor included in the mobile robot and receiving the time synchronization signal.

15. The apparatus of claim 14, wherein a speed of transmission of the time synchronization signal is faster than a speed of transmission of the sound wave.

16. The apparatus of claim 14, wherein the time synchronization signal is one of an infrared (IR) signal or a radio frequency (RF) signal, and the sound wave is an ultrasonic wave.

17. The apparatus of claim 14, wherein the distance between the designated location and the mobile robot is calculated based on a gap between a time when the time synchronization signal receptor receives the time synchronization signal and a time when the sound wave receptor receives the sound wave.

18. The apparatus of claim 13, further comprising:

a first timer included in the designated location and generating a timing signal with which the sound wave is transmitted to the mobile robot in synchronization; and

a second timer included in the mobile robot and generating the same timing signal as that provided from the first timer.

19. The apparatus of claim 18, wherein the distance between the designated location and the mobile robot is calculated based on a difference between a time when the second timer generates a timing signal and a time when the sound wave receptor receives the sound wave from the sound wave transmitter.

20. The apparatus of claim 13, further comprising:

a compensator which receives inputs of a linear velocity command and an angular velocity command provided by the travel controller, the travel distance and the travel direction information of the mobile robot provided by the encoder, and distance information between the designated location and the mobile robot calculated by the distance calculator, and by using a Kalman filtering technique, compensates for an error between a travel distance measured by the encoder and the actual travel distance.

21. The apparatus of claim 13, wherein if the mobile robot approaches the designated location, the travel controller controls the mobile robot to travel according to the first direction angle and if the mobile robot moves away from the designated location, the travel controller calculates a second direction angle of the mobile robot at the third location and controls the mobile robot to travel according to the second direction angle.

22. The apparatus of claim 13, wherein the travel controller calculates the first direction angle by using the first distance between the mobile robot at the first location and the designated location, the second distance between the mobile robot at the second location, and the designated location, and the travel distance between the first location and the second location.

23. The apparatus of claim 21, wherein the travel controller calculates the second direction angle by using the second distance, a third distance between the mobile robot at the third location, arrived at after the mobile robot rotates by the first direction angle in an arbitrary direction at the second location and travels a predetermined distance, and the travel distance between the second location and the third location.

24. The apparatus of claim 23, wherein if at the second location the mobile robot rotates in the direction of increasing distance from the docking station, the travel controller estimates the distance between the mobile robot at the third location and the designated location, and if the third distance is different from the estimated distance, controls the mobile robot to travel according to the first direction angle, and if the third distance is the same as the estimated distance, controls the mobile robot to travel according to the second direction angle.

25. The apparatus of claim 24, wherein the travel controller determines the rotation direction of the second direction angle according to whether the first direction angle is an acute angle or an obtuse angle.

26. A computer readable medium encoded with processing instructions for performing a method of allowing a mobile robot to return to a designated location, wherein the designated location has a sound wave transmitter and the mobile robot has a sound wave receptor and the mobile robot automatically returns from a first location to the designated location, the method comprising:

calculating a first direction angle of the mobile robot at a second location arrived at after the mobile robot travels a first distance from the first location;

determining whether the mobile robot approaches or moves away from the designated location, at a third location arrived at after the mobile robot rotates by the first direction angle and then travels a second distance; and

if the result of the determination indicates that the mobile robot approaches the designated location, controlling the mobile robot to travel according to the first direction angle, and if the result indicates the mobile robot moves away from the designated location, calculating a second direction angle of the mobile robot at the third location, and controlling the mobile robot to travel according to the second direction angle.

27. The computer readable medium of claim 26, wherein the first and second direction angles are calculated by using a distance between the mobile robot and the designated location calculated from a time difference between a time when the sound wave transmitter transmits a sound wave and a time when the sound wave receptor receives the sound wave, and a travel distance provided by an encoder connected to a motor of the mobile robot.

28. / The computer readable medium of claim 26, wherein the calculating the first direction angle comprises:

at the first location, calculating a first distance between the mobile robot and the designated location;

after traveling the mobile robot to the second location from the first location, calculating at the second location a second distance between the mobile robot and the docking station; and

calculating the first direction angle by using the first distance, the second distance and a travel distance between the first location and the second location.

29. The computer readable medium of claim 28, wherein the determining whether the mobile robot approaches or moves away from the designated location comprises:

rotating the mobile robot by the first direction angle in an arbitrary direction and traveling the mobile robot to a third location;

at the third location, calculating a third distance between the mobile robot and the designated location;

estimating the distance to the designated location from the third location after the mobile robot rotates by the first direction angle in the direction of increasing distance from the designated location and travels a predetermined distance between the second location and the third location; and

comparing the calculated third distance with the estimated distance.

30. The computer readable medium of claim 29, wherein the controlling the mobile robot to travel comprises:

calculating a second direction angle of the mobile robot by using the second distance, the third distance and the travel distance between the second location and the third location;

if the result of the comparison indicates that the third distance is different from the estimated distance, controlling the mobile robot to travel according to the first direction angle; and

if the result of the comparison indicates that the third distance is the same as the estimated distance, controlling the mobile robot to travel according to the second direction angle.

31. The computer readable medium of claim 30, wherein rotating the mobile robot by the first direction angle in an arbitrary direction comprises:

if the first direction angle is an acute angle, the rotation direction of the second direction angle is controlled to be opposite to the rotation direction of the first direction angle; and

if the first direction angle is an obtuse angle, the rotation direction of the second direction angle is controlled to be the same as the rotation direction of the first direction angle.

32. The computer readable medium of claim 27, wherein the time difference between the time of transmitting the sound wave from the designated location incident on the mobile robot, and the time of receiving the sound wave is calculated based on the transmission and reception time points of a predetermined time synchronization signal from the designated location incident on the mobile robot.

33. The computer readable medium of claim 32, wherein a speed of transmission of the time synchronization signal is faster than a speed of transmission of the sound wave.

34. The computer readable medium of claim 32, wherein the time synchronization signal is one of an infrared (IR) signal or a radio frequency (RF) signal, and the sound wave is an ultrasonic wave.

35. The computer readable medium of claim 27, wherein the time difference between the transmission time and the reception time of the sound wave from the designated location incident on the mobile robot is calculated based on a predetermined timing signal.

36. The computer readable medium of claim 27, wherein the travel distance provided by the encoder is compensated for an error caused by slipping on a ground, by a Kalman filtering technique using the first through third location information.

37. The computer readable medium of claim 26, wherein a program enabling the method is recorded on a computer-readable recording medium.

38. The method according to claim 1, wherein the designated location is a docking station.

39. The apparatus according to claim 13, wherein the designated location is a docking station.

40. The computer readable medium of claim 26, wherein the designated location is a docking station.